Claims

1. Method for producing silicon nitride films by vapor-phase growth, said method being characterized by

feeding a hydrazine gas and at least 1 precursor gas selected from the group consisting of trisilylamine gas and a silylhydrazine gas into a reaction chamber that holds at least 1 substrate and

forming a silicon nitride film on said at least 1 substrate by the reaction of the two gases.

2. The production method described in claim 1, characterized in that the aforesaid silylhydrazine is defined by formula (I)

$$H_3Si(R^a)N-N(R^b)R^c \qquad (I)$$

wherein R^a, R^b, and R^c are each independently selected from silyl, the hydrogen atom, methyl, ethyl, and phenyl.

3. The production method described in claim 1 or 2, characterized in that the aforesaid precursor gas is a silylhydrazine gas and said silylhydrazine is fed into the aforesaid reaction chamber by the introduction into said reaction chamber from a synthesis chamber of a silylhydrazine-containing reaction mixture produced by the reaction in said synthesis chamber of a silylamine gas and a second hydrazine gas.

4. Production method as described in any of claims 1-3, characterized in that the hydrazine fed into the aforesaid reaction chamber is defined by formula (II)

$$H(R^1)N-N(R^2)R^3 \qquad (II)$$

wherein R^1, R^2, and R^3 are each independently selected from the hydrogen atom, methyl, ethyl, and phenyl.

5. The production method described in claim 3 or 4, wherein the aforesaid silylamine is defined by formula (III)

$$(H_3Si)_mN(H)_{3-m} \qquad (III)$$

wherein **m** is an integer from 1 to 3.

6. Production method as described in any of claims 3 to 5, characterized in that the aforesaid second hydrazine is defined by formula (IV)

$$H(R^x)N-N(R^y)R^z \qquad (IV)$$

wherein R^x, R^y, and R^z are each independently selected from the hydrogen atom, methyl, ethyl, and phenyl.

7. Production method as described in any of claims 1 to 6, characterized in that the temperature of the reaction between the aforesaid precursor gas and the aforesaid hydrazine gas is set at 300°C to 700°C.

8. Production method as described in any of claims 1 to 7, characterized in that a pressure of 0.1 torr to 1,000 torr is established in the aforesaid reaction chamber.

9. Production method as described in any of claims 1 to 8, characterized in that an inert dilution gas is also fed into the aforesaid reaction chamber.

10. Method for producing silicon nitride films by vapor-phase growth, said method being characterized by

feeding a silylhydrazine gas into a reaction chamber that holds at least 1 substrate and

forming a silicon nitride film on said at least 1 substrate by the decomposition of said silylhydrazine gas.

11. The production method described in claim 10, characterized in that the aforesaid silylhydrazine is defined by formula (I)

$$H_3Si(R^a)N-N(R^b)R^c \qquad (I)$$

wherein R^a, R^b, and R^c are each independently selected from silyl, the hydrogen atom, methyl, ethyl, and phenyl.

12. The production method described in claim 10 or 11, characterized in that the aforesaid silylhydrazine is fed into the aforesaid reaction chamber by the introduction into said reaction chamber from a synthesis chamber of a silylhydrazine-containing reaction mixture produced by the reaction in said synthesis chamber of a silylamine gas and a hydrazine gas.

13. Production method as described in claim 12, characterized in that the aforesaid hydrazine is defined by formula (IV)

$$H(R^x)N-N(R^y)R^z \qquad (IV)$$

wherein R^x, R^y, and R^z are each independently selected from the hydrogen atom, methyl, ethyl, and phenyl.

14. Production method as described in claim 12 or 13, wherein the aforesaid silylamine is defined by formula (III)

$(H_3Si)_mN(H)_{3-m}$ (III)

wherein **m** is an integer from 1 to 3.

15. Production method as described in any of claims 10 to 14, characterized in that decomposition of the aforesaid silylhydrazine gas is carried out at 300°C to 700°C.

16. Production method as described in any of claims 10 to 15, characterized in that a pressure of 0.1 torr to 1,000 torr is established in the aforesaid reaction chamber.

17. Production method as described in any of claims 10 to 16, characterized in that an inert dilution gas is also fed into the aforesaid reaction chamber.